SUMMARY REPORT

EPA Internal Review of the August 5, 2015 Gold King Mine Blowout

8/24/2015

Purpose:

The purpose of this report is to provide the EPA Internal Review Team's (Team) assessment of the events and potential factors contributing to the blowout from the Gold King Mine (GKM) in Colorado on August 5, 2015. This report provides the Team's observations, conclusions, and recommendations that regions may apply to ongoing and planned site assessments, investigations, and construction or removal projects at similar types of sites across the country.

Team Charge:

The Assistant Administrator of the Office of Solid Waste and Emergency Response (OSWER) charged a subgroup of the National Mining Team on August 14, 2015 to conduct a rapid analysis of the Gold King Mine (GKM) release and provided them with the following charge:

The EPA Gold King Mine Internal Review Team (Team) is charged with conducting an internal review of the August 5, 2015, release of approximately 3,000,000 gallons of mine wastewater from the Gold King Mine near Silverton, CO. This review will entail developing a detailed, chronological description of events as well as identifying potential factors contributing to the release. The review may include recommendations that regions may apply to ongoing and planned site assessments, investigations, and construction or removal projects. The review will include:

- *A visit, during the week of August 16, 2015, to the Gold King Mine site to observe post-August 5 site release conditions.*
- *Interviews with the on-site EPA On-Scene Coordinator and other appropriate EPA staff, appropriate contractor representative(s) (e.g., Emergency Response and Rapid Services [ERRS], Superfund Technical Assessment and Response Team [START] contractor), and others, e.g., State, other Federal agency/departmental personnel, as appropriate, to document their recollections of the event. Interviews shall not interrupt response.* [See Attachment B for a list of people interviewed.]
- *Interviews to be conducted using guidelines to be included in a briefing from the Office of the General Counsel.*
- *Review of pertinent site documentation, (e.g., work plan, schedule, quality assurance response form, other pertinent technical/engineering/contractual documents/any photographic records) to identify potential factors contributing to the release.*

- *Potential coordination with the subsequent external review being conducted by the US Department of Interior/Bureau of Reclamation and US Army Corps of Engineers thereby minimizing the impact to response operations.*

- *Any recommendations to implement at similar sites, both ongoing and new, based on the results of the Team's review.*

A senior manager from OSRTI will be identified to facilitate the identification of individuals to be interviewed, agencies to engage, etc. The Team will develop a preliminary report addressing the information above and deliver it electronically to the OSWER Assistant Administrator by Monday, August 24, 2015. If necessary, the team may also indicate if additional gaps need to be filled, and the timeframe it would take to fill those gaps.

Scope of Team Review:

The Team was asked to conduct a one week rapid assessment of the GKM Blowout. From August 15 to August 24, 2015, the Team performed a site visit, interviewed key individuals, reviewed available information, and drafted a report.

EPA's Internal Review Team consisted of the following: individuals:

John Hillenbrand, CEG, EPA Region 9 – Team Leader
Joshua Wirtschafter, Assistant Regional Counsel, EPA Region 9
Ed Moreen, P.E. Civil, EPA Region 10
Lisa Price, Geologist, EPA Region 6
Shahid Mahmud, Environmental Engineer, EPA Headquarters

The following are the attachments included in this report:

Attachment A: List of documents reviewed by the Team
Attachment B: List of interviewees
Attachment C: Map of Mine Workings
Attachment D: Working Assumptions Diagram of conditions at new Gold King Mine Level 7 Portal
Attachment E: Gold King Mine Flow Data and Chart
Attachment F: Report Photos
Attachment G: Photo log from 2014 and 2015 Removal Investigation activities

In addition, the Team conducted a limited review of internet resources to determine if there are existing guidelines or procedures for investigating sites with similar characteristics as this site.

Background Information:

The following is the chronology of pertinent site events.

1880's – The Gold King Mine began operation.

Mid-1900's – The Gold King Mine operations ceased; mining had occurred at seven (7) different elevations (levels) through three (3) adits: the Level 7, Number 1, and Sampson. Historical mine water levels could not be ascertained by the team during the review period.

Mid-1900's -- The American Tunnel was constructed below the lowest mine workings in the area (Attachment C: Map of Mine Workings). It runs from the drainage adit discharge point in Gladstone, beneath the Gold King Mine and eventually reaches the Sunnyside mine complex approximately two (2) miles northeast. During operation of the American Tunnel it effectively drained the Gold King and Red and Bonita Mines. It passes 500 feet directly beneath the Gold King Mine Level 7 adits. Anecdotal information puts construction in the early to mid-1900's. A treatment plant was constructed to treat the water from the tunnel prior to release to Cement Creek. The date of construction of both the water treatment plant and the American Tunnel could not be ascertained during the review period.

1986 – A permit was issued to the Gold King Mines Corporation (Permit Number M-1986-013) by the state of Colorado to re-work the historic interconnected adits. During the permitted mine operations, another adit was driven at the Gold King Level 7 (the Adit) to bypass a collapse in the original Gold King Level 7 Adit (the Old Adit).

2002 – Treatment of the discharge water from the American Tunnel ceased after installation of the last bulkhead. Flow from the American Tunnel continued after the installation of the bulkhead at approximately 100 gallons per minute (gpm). Since closure of the American Tunnel, the water quality in the Animas River has degraded progressively due to the impact of drainage from the American Tunnel and other newly draining adits.

2005 – No documentation of flow for the Adit is available before July 2005. Anecdotal information suggests that the Red and Bonita Mine, which did not have any previously documented mine water discharge, began releasing approximately 300 gpm of water after the American Tunnel closure. The Adit also experienced an increase after the American Tunnel closure from no significant flow to flow rates of approximately 42 gpm in July and 135 gpm in September[1]. (See Attachment E: Gold King Mine Flow Data and Chart)

2006 – Mine water flow rate from the Adit was approximately 314 gpm[1] in October.

2007 – Release of mine water from the Old Adit breached the existing discharge ditch and saturated the mine waste pile. The saturated conditions led to a slope failure that partially blocked access to the site and filled the North Fork of Cement Creek with mine waste. The quantity of mine water discharged is not known.

[1] The Team could not ascertain in the time allowed if flow rates represent composite for both the Old Adit and the Adit or just the Adit

2008 – The Colorado Division of Reclamation, Mining & Safety (DRMS) constructed a discharge diversion structure (flume channel) to prevent future mine water saturation of the Gold King Level 7 mine waste pile at the Old Adit. This work was paid for by the forfeiture of the bond associated with the permit issued in 1986, M-1986-013.

2009 – The DRMS's Gold King Mine Reclamation Plan called for all four (4) adits of the Gold King complex to be backfilled and the installation of a flume to divert the discharge. The two (2) Gold King Level 7 adits (Adit and Old Adit) were partially collapsed already but additional closure work was conducted. This work was paid for by the forfeiture of the bond associated with the permit issued in 1986, M-1986-013. DRMS stated in the project summary for the activities that "[a] future project at the site may attempt to cooperatively open the Level 7 Old Portal in an effort to alleviate the potential for an unstable increase in mine pool head within the Gold King workings." The Old Adit was releasing roughly 200 gpm.

2010 – The average mine water flow rate from the Gold King Level 7 mine was 206 gpm[1].

2011 – The average mine water flow rate from the Gold King Level 7 mine was 140 gpm[1].

2014 – EPA planned to expose the Adit in 2014 – EPA was working with DRMS and the Animas River Stakeholder Group (ARSG), which is composed of industry, agency and citizens including former miners and equipment operators who have worked on some of the mine adit closures in the area of Gold King, to identify actions that may be needed to reduce contaminant loading to Cement Creek and downstream waters. This included a plan to install bulkheads at the Red and Bonita Mine. It was determined appropriate to attempt to open the Adit prior to restricting flow at the Red and Bonita Mine with a bulkhead and potentially changing the water level elevations in the Red and Bonita Mine. To accomplish this objective, EPA planned to expose the Adit behind the external blockage, build a portal structure, and convey Adit flows into the existing channel (see Attachment D). This was being done to allow access for further investigation of the Adit. The flow rate data from the Gold King Level 7 mine was approximately 112 gpm in August, 2014, however, on September 11, 2014 prior to the beginning of site work, the flow rate was less than 13 gpm.[1]

A retention pond was constructed to capture solids that might be released during the Adit work. On September 11, work began to remove the material that was blocking the Adit. The excavation extended approximately 20 feet into the Adit entrance. The work stopped when it was determined that the elevation of the Adit floor was estimated to be six (6) feet below the waste-dump surface elevation. EPA determined that Adit drainage would need to be managed in a larger settling pond(s) requiring additional treatment.

The excavation in 2014 revealed that two (2) 24-inch pipes were in the tunnel blockage adjacent to the top (roof) of the maximum 10 foot tall Adit. (See Diagram in Attachment D). The presence of water below the two (2) 24-inch pipes indicated the current flow of water was coming out at least four (4) feet below the roof of the Adit, indicating approximately six (6) feet of impounded water above the estimated Adit floor elevation.

On September 12, two (2) drain pipes were placed at the base of the blockage to capture the on-going mine water drainage and direct flow into the existing flume channel installed in 2008 by DRMS. Geo-fabric, crushed rock, and quick-dry concrete was used to secure the pipes in place. The Adit area was backfilled and compacted with additional loads of crushed rock to maintain a stable surface at the Adit for potential future work. Field work was suspended for the rest of the year.

2015 – Based on information acquired in 2014, EPA, again, planned to reopen the Adit and workings to investigate the conditions to assess the ongoing releases of mine water. This would require incremental de-watering and removal of internal blockages that were preventing the release of impounded water. A secondary purpose of the work is to attempt to gain access to the mine workings and to mitigate flows, if possible.

In January and May, 2015, the ARSG held meetings, open to the public, where DRMS and EPA presented their plans for removal investigation at the Adit. The Meeting Summaries posted by ARSG do not record any stakeholder criticism of the planned approach.

EPA returned to the Adit in late July, initiating site preparations with reconstruction of the access road and installation of an alternative mine drainage pipe at a deeper depth in anticipation that the Adit floor is lower than the other drainage pipes installed in 2014.

On August 4, excavation began above the top of the Adit to remove consolidated soils and debris. The goal was to find competent bedrock within which to anchor a support structure for the Adit. During this first day of excavation, according to the OSC, mine timbers and the external Adit blockage were newly exposed

On August 5, excavation resumed. The OSC observed a solid rock surface and constructed a ramp above the external Adit blockage to remove soil from the bedrock surface. During the excavation, the lower portion of the bedrock face crumbled away and there was a spurt of water from the area in the lower part of the excavation area. Shortly after the water spurted, more water started coming from the localized area of the spurt. The color of the water was initially clear but then changed to red/orange. The OSC speculated that the excavation might have knocked something lose when removing the soils from the rock face.

The time lapse between the spurting to the flow of red/orange water was 3 to 4 minutes. It took approximately 1 hour for the peak flow to subside.

Observations Related to the Release:

The Team interviewed key personnel involved with the Adit blowout from EPA Region 8 on August 17, 2015, to document their recollections of the event and to get pertinent site documents and other information on the site. EPA Region 8's personnel provided a package of key site-related documents, pictures of the site, and site diagrams. On August 18, 2015, the lead OSC from Region 8 led a site visit of the Gold King Mine. Senior mining experts from the DRMS also participated in this site visit. The Team asked the State experts about their understanding of the site and recollection of the events at the Adit and the upper Animas River mining district.

The August 18 tour included stops at: the American Tunnel entrance with an explanation of the underground working by DRMS; the road above the series of ponds that treat the post-blowout drainage from the Adit (see Appendix F, photo 1); the Gold King Mine area; and both the Old Adit and the Adit. No stop was made at the Red and Bonita Mine (Appendix F photo 2 and Attachment C, map of workings).

In addition to bringing an understanding to the chronology of events listed above, the site visit and work plan provided the following supplemental information:

- The work plan accounted for the possibility of pressurized (mine water with a head high enough to cause water to exit the Adit at high velocity) mine water conditions. In the introduction, the work plan states:

  > "Conditions may exist that could result in a blow out of the blockages and cause a release of large volumes of contaminated mine waters and sediment from inside the mine, which contain concentrated heavy metals."

- The work plan outlined the steps to be taken such as gradually lowering the debris blockage and the use of equipment (stinger) that would help control drainage from the mine under non- or slightly pressurized conditions. A stinger is a metal pipe that is inserted from above the top of the mine adit front at an angle, through the debris and collapse blockage into the void behind the blockage, allowing drainage and control of mine water.

- For the Adit, a determination of no or low mine water pressurization was made by experienced professionals from EPA and the DRMS. Based on discussions with the EPA and State people associated with the site, this determination was based on the following conditions:

  1. The hill above the Adit was inspected for seeps which would have indicated outward flow from mine water that had a pressure head above the top of the Adit. It was reported that there were no seeps.
  2. The mine was draining, which indicated that since water was able to escape, buildup of pressure was less likely.
  3. The DRMS experts, (b) (6) who supported the removal investigation, had worked in the area for years, were familiar with the site and knew the details of the operation and area hydrology
  4. The Animas River Stakeholders Group (ARSG) had been given a presentation by (b) (6), EPA's On-Scene Coordinator (OSC), and (b) (6) with DRMS, as documented in the May ASRG Meeting Summary.
  5. The DRMS experts supported the removal investigation at the Adit and were present at the site during the operations on August 4 and 5.
  6. The "seep" level coming from the Adit during excavation seemed to be at the mid-level of the material blocking the Adit, indicating a partially filled adit as opposed to a pressurized one (See Attachment D, bottom of two metal pipes).

7. The Red and Bonita Mine Adit was lower in elevation (a few hundred feet) and found to be unpressurized after it was accessed by drilling from above.
8. The DRMS experts indicated that similar techniques have been employed at other similar mine sites. One DRMS expert noted that a similar investigation technique was implemented at the Captain Jack Mine in Colorado but did not result in a blowout.

- Despite the available information suggesting low water pressure behind the debris at the Adit entrance, there was, in fact, sufficiently high pressure to cause the blowout. Because the pressure of the water in the Adit was higher than anticipated, the precautions that were part of the work plan turned out to be insufficient. The inability to obtain an actual measurement of the mine water pressure behind the entrance blockage seems to be a primary issue at this particular site. If the pressure information was obtained, other steps could have been considered. However, the Team cannot determine whether any such steps would have been effective, or could have been implemented prior to a blowout.

- Mine water pressurization data from behind the blockage potentially could have been obtained through a drill hole inserted further back into the Adit from above the mine tunnel. Such a technique was performed at the nearby Red and Bonita Mine and found no pressurization. Consequently, it was determined that the tunnel was not full of water and excavation of the Adit at that mine could proceed. Such a technique was not used at the Adit. Based on the site topography (steepness and ruggedness) observed by the Team and conversations with the OSC and the DRMS experts, (See Attachment F, first photo) the use of such a technique would have been very difficult and expensive at the Adit. The unstable and steep slope above the Adit had loose soils and rock and the underlying bedrock was prone to cave-ins, as observed over the nearby Old Adit (See Attachment F, photo 3). Because of the soil and rock conditions, the access and drilling of a hole into the Adit from above would have been quite costly and require much more planning and multiple field seasons to accomplish. Although difficult and therefore expensive and technically challenging, this procedure may have been able to discover the pressurized conditions that turned out to cause the blowout.

- An additional potential clue of potential pressurization was the decrease in flows from the Gold King Adits over the years (Attachment E). That decrease could have been an indication of impounded water from a blockage. The mine drainage flow before 2005 was understood to be zero and increased from 42 gpm in 2005 to 135gpm in September 2005 and peaked at 314 gpm in October 2006. This increase is attributed to rising groundwater in the Gold King Mine workings from plugging of the back portion of the American tunnel in 1995 and possibly 2002. The average flows in 2010 dropped to 206 gpm, further dropped to an average of 140 in 2011 and finally to about 70 gpm or less in the past year. These conditions may indicate some type of internal change to the mine such as additional cave-ins, or a restriction due to already caved material, perhaps by chemical precipitates, or some other cause. It is also possible that the reduced flows could have been attributed to decreased precipitation in the area or increased flows from the American Tunnel.

- The Team was not able to identify any calculations made on the possible volume of water that could be held behind the portal plug. This calculation could have been useful in determining possible response scenarios for unexpected releases.

- The Request for Proposals (RFP) that included the work at the Adit project requested a plan for dealing with mine water flow and also states that the blockage in the Adit must be removed in a manner to prevent a surge of impounded mine water from being released. It called for the water impounded behind the blockage to be drawn down in a controlled manner as the blockage is removed. Upon review of the work plan, the contractor provided a description and conceptual drawing for dealing with the water (Attachment D). However, the Team believes that Emergency Action Plan (EAP) included with the site plan did not anticipate or plan for the volume or pressure encountered and contained only limited emergency procedures in case of a mine blowout. This lack of information about a blowout in the EAP could indicate the low expectation of its occurrence by the contractor and reviewers. These procedures and contacts may have been included in the Site Health and Safety Plan but this document could not be obtained in time for this report.

Conclusions:

Based on the review of the available information, including the interviews, documents and site visit, the Team is providing the following conclusions:

1. The EPA site removal investigation team had extensive experience with the investigation and closure of mines. The EPA site removal investigation team had consulted with and had the field support of the DRMS. The EPA site removal investigation team also performed outreach to the ARSG, to provide an opportunity for additional input regarding the planned activities. The EPA site removal investigation team and the other entities consulted or who provided information about the proposed activities had extensive site knowledge of the mine workings and extensive experience evaluating and working on mine sites. None of those participating or informed parties raised any significant concerns with the proposed activities.

2. In preparation for the investigation activities, EPA had collected and analyzed flow data, was familiar with site topography, and had inspected the site for signs of seeps, including the area above the Adit, prior to implementing the execution of the work plan.

3. It is not evident that the potential volume of water stored within the Adit had been estimated. Given the maps and information known about this mine, a worst case scenario estimate could have been calculated and used for planning purposes. When adequate information is available, performing such calculations may aid the site management team in instances where water is anticipated to be trapped in an adit. The interconnectivity of

mine workings could be used to estimate potential water volume prior to opening up a collapsed adit.

4. Additional expert opinions may be warranted for sites with collapsed adits, complex interconnectivity of mine workings, and highly transmissive bedrock groundwater systems.

5. The work plan contained an EAP which included provisions for mine emergencies including cave-ins. However, based on the documents reviewed by the Team, it was lacking emergency protocols in the case of a significant flow or blow out. It should be noted that the site team responded appropriately during and after the blowout by moving personnel and equipment and diverting mine water discharge. Such provisions are an important component of an EAP on sites such as the Gold King Mine. There may have been some contingencies planned in case of a blowout, but it could not be ascertained by the Team during the review period.

6. The Adit is located in a remote, rugged mountain location in the Rocky Mountains. The level of effort necessary to mobilize a drill rig and create a drill pad to undertake drilling or other investigative techniques to determine pressure (hydrostatic head) within the mine would require significant resources and add additional time to the implementation schedule and may not be successful in ascertaining water levels or pressure within the mine. Safety is a key consideration for drilling at the Gold King site, and establishing a safe location for the drill pad would be very challenging given the steepness and instability of the slopes above and in proximity to the Adit. Drilling to hit a target such as an adit or tunnel can be very challenging if the drill pad cannot be located in close proximity the adit entrance. It can also be a lengthy process and require considerable effort and expense. However, if it could be performed successfully and safely, drilling could provide the information needed to ascertain the pressure behind the collapsed workings within the mine.

7. In reviewing the pertinent documents provided, interviews conducted, visiting the site and evaluating the photo logs, the Team concludes that the Adit blowout was likely inevitable. Actions taken by the EPA OSC to pull out the site personnel and crew from and near the Adit, just prior to the blowout, probably avoided any fatalities from the pressurized Adit blowout.

8. Although the removal investigation team was quite experienced and followed standard procedures of a well thought out work plan that included state and ARSG involvement, the underestimation of the water pressure in the Gold King Mine workings is believed to be the most significant factor relating to the blowout.

9. A limited review of internet resources did not reveal any existing guidelines or procedures for assessing highly pressurized mine adits or tunnels, such as Gold King Mine.

Recommendations:

1. EPA should develop guidance to outline the steps that should be undertaken to minimize the risk of an adit blowout associated with investigation or cleanup activities. The guidance, at a minimum, should:
   - **a.** Identify a tiered approach that requires increased detail regarding the proposed action based on the complexity of the site conditions or the potential nature of any release.
   - **b.** Provide criteria to identify whether a proposed investigation or cleanup action presents a low, moderate, or high risk with respect to the potential for an adit blowout and significant release of acid mine drainage or mine waste.
   - **c.** Require that a management review meeting(s), including the key state (and other federal agencies when appropriate) be held to determine whether sufficient information exists to meet the criteria established in the guidance or whether additional information is necessary before undertaking the investigation or cleanup activity.
   - **d.** Outline the outreach activities to inform the local community and stakeholders.
   - **e.** Identify the contingency planning that may be appropriate based upon the risk of blowout and the nature of the potential release.

2. Even though the chance of encountering pressurized mine water was investigated in many ways at the Gold King Mine, the Gold King Mine blowout suggests that EPA should develop a toolbox of additional investigative tools such as remote sensing or drilling into the mine pool from the top or side that should be more seriously considered at similar sites. It's important to recognize that underground mines may be extremely complex, making characterization of the internal hydraulic conditions and flow paths challenging. Adding to this complexity is that older mine workings are often not well mapped and that some underground mines may also be structurally unstable and prone to cave-ins and internal plugging making them very difficult to assess. The toolbox should identify techniques which could be used to minimize uncertainties associated with these types of mines. Site specific conditions may make certain investigative tools prohibitive or extremely challenging and costly. In the end, while additional information gathering may reduce the uncertainty, a complete understanding of the underground conditions may not be attainable.

3. Emergency Action Plans should include protocols should a blowout occur at those mine sites where there is a potential for such an event to occur.

4. Information and rationale developed by a site team in anticipation of an investigation or cleanup action for sites where an adit blowout could be a concern (e.g., available pressure information, a reasonable estimate of the volume of water within the mine workings, or adit drainage flow rate data) should be critically reviewed by a qualified and experienced Regional Mining engineer and or Mining Hydrologist/Geologist. The Region may want to consider getting assistance from qualified outside parties such as other federal agencies, state agencies, or outside consultants in conducting this critical review.

5. The Team also recommends that subsequent reviews of the Gold King Mine Adit Blowout by an Independent External Review Group or the Office of Inspector General consider the possibility of assembling a panel of experts consisting of mining industry experts, other federal and state mining experts, academia, consultants, non-governmental organizations and tribal governments to further analyze the situation encountered at this site and come up with recommendations on additional safeguard measures to reduce the risk and minimize the consequences of such incidents in the future.

Attachment A
List of documents reviewed by the Team

Animas River Stakeholders Group, January 2015, Meeting Summary, 3 p.

Animas River Stakeholders Group, May 2015, Meeting Summary, 3 p.

Colorado Division of Reclamation, Mining & Safety, 2008, Project Summary: Gold King Bond Forfeiture M-1986-013, Phase I – 2008, Permanent Portal Discharge Diversion Structure, 2 p.

Colorado Division of Reclamation, Mining & Safety, 2009, Project Summary: Gold King Bond Forfeiture M-1986-013, Phase II – 2009 Reclamation at the Sampson, Number One, and Level Seven Portals, 4 p.

Colorado Division of Reclamation, Mining & Safety, 2014, Approximation of Mine Portal Elevations and Mine Pool Elevations Map, 1 p.

Colorado Division of Reclamation, Mining & Safety, 2015, Red and Bonita, Sunnyside, Gold King, and Mogul and Grand Mogul Mine Workings Map, 1 p.

Environmental Protection Agency, September 2014, POLREP#1 (Initial Pollution Report) – Removal Assessment, Gold King Mine Site, 9 p.

Environmental Protection Agency, August 2015, Gold King – EPA Working Assumptions, 2 p.

Environmental Restoration, LLC, July 2014, Request for Proposal, Gold King Mine, 16 p.

Environmental Restoration, LLC, May 2015, Action/Work Plan, Gold King Mine, 6 p.

Attachment B

List of key personnel interviewed EPA Internal Review Team of the Gold King Mine Spill, Colorado

The EPA Internal Review Team conducted a series of interviews with key personnel involved in deciding how to proceed with the removal assessment at the site and or who were present at the site prior to the release at the Gold King Mine site in Colorado. The team asked these key personnel about what information they reviewed and considered prior to making the decision to proceed with the removal assessment at the site and what kind of actual field conditions they encountered just prior to the spill. The list below provides the names and affiliations of the key personnel interviewed by the EPA's Internal Review Team.

Key Personnel Interviewed

Formal interviews were held on August 17, 2015, were held at the Recreation Center in Durango, Colorado. The personnel included:

(b) (6) - Program Director, USEPA Region 8 Preparedness, Assessment and Emergency Response Program

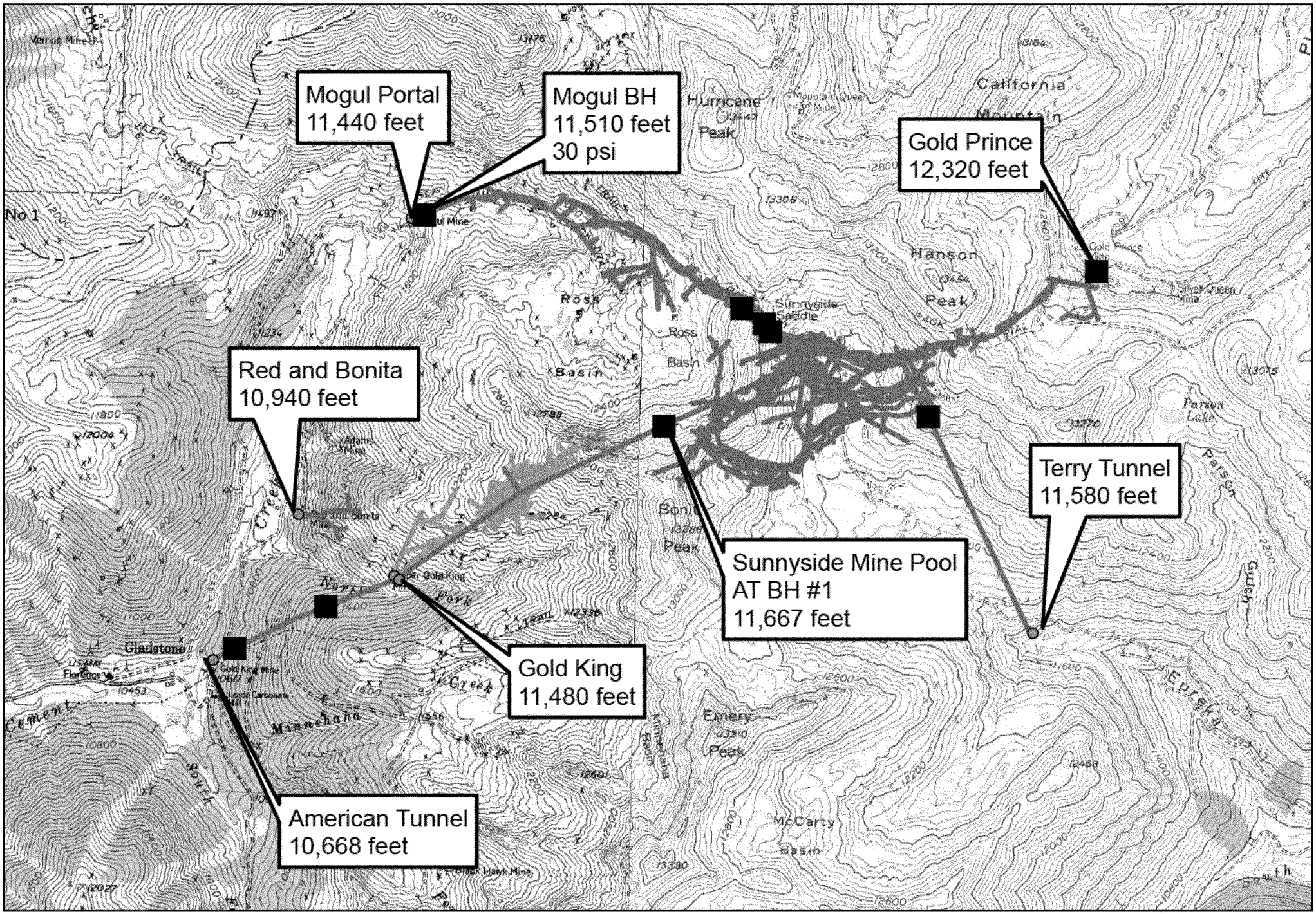
(b) (6) USEPA Region 8 On-Scene Coordinator

(b) (6) (by phone) - USEPA Region 8 On-Scene Coordinator

During the site visit to the Gold King Mine site on August 18, 2015, the EPA Internal Review Team talked (informal discussions) with the following personnel:

(b) (6) Colorado Division of Reclamation Mining and Safety

(b) (6) Colorado Division of Reclamation Mining and Safety



Mine and Pool Elevations

0 0.15 0.3 0.6 0.9 1.2 Miles

Approximation of Mine Portal Elevations and Mine Pool Elevations
Created for ARSG
(b) (6)
4/17/2014

N W E S

1805088

ED_000689_00000993-00014

Gold King Mine

2015

EPA Working Assumptions

CLIENT/SUBJECT: Gold Kuroko Assumptions

TASK DESCRIPTION: EPA W [redacted]

PREPARED BY: (b) (6) DEPT START RS DATE

MATH CHECKED BY: (b) (6) DEPT START RS DATE

METHOD REV. BY: TS DEPT DATE

SHEET ___ OF ___

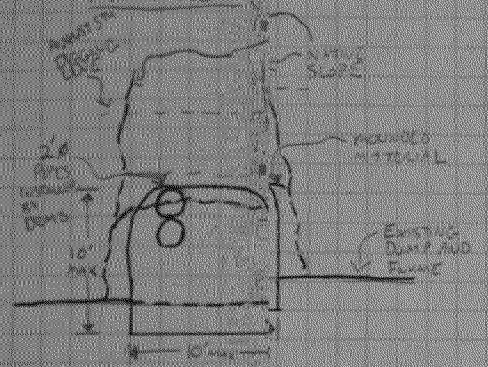
W.O. NO.

TASK NO.

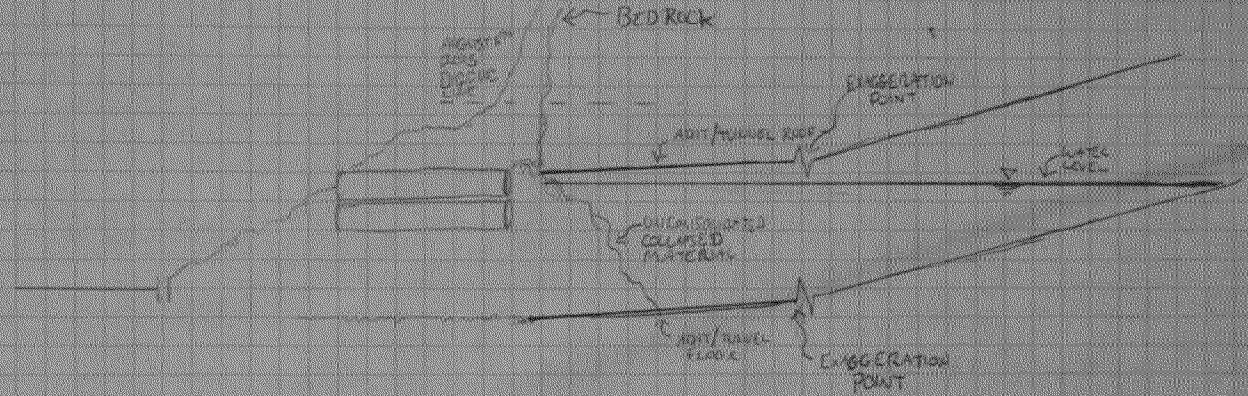
APPROVED BY

DEPT DATE

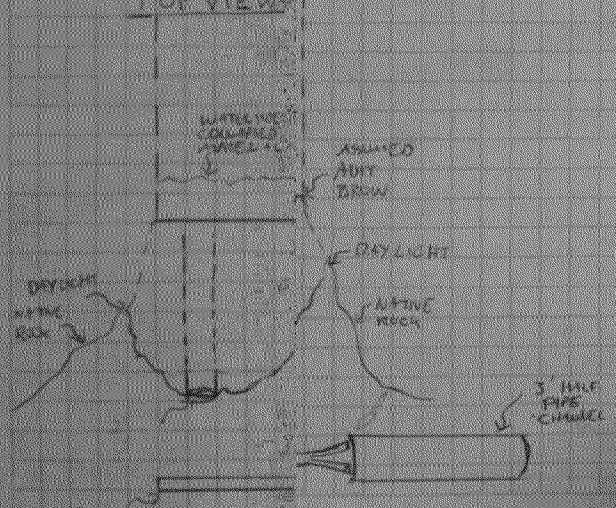
FRONT VIEW N.T.S.



SIDE VIEW N.T.S.



TOP VIEW N.T.S.



Attachment E

Gold King Mine Flow Data and Chart

Flow from Gladstone Area Mines

The annual discharge of water from the Gold King Mine and 3 nearby mines (Mogul, Red and Bonita, and American Tunnel) was estimated using ESAT data from 2009 through 2014 (Table 1). The average annual runoff flow and the average annual non-runoff flows were weighted to estimate overall annual flow. The four mines discharge approximately 330 million gallons of water per year (based on 2009-2014 flow data). Additional mines in the area also release acid mine drainage. The recent release of 3 million gallons is less than 1 percent of the annual discharge from the four mines.

TABLE 1
Historic Annual Flows from 4 Mines (Mogul, Red and Bonita, Gold King and American Tunnel)
2009-2012

	4 Mines Flow			CC06 Flow			
	Flow (cfs)	Days	Annual Flow (gpy)	Flow (cfs)	Days	Annual Flow (gpy)	% of Total
Average of Yearly Average Flow*							
Non-Runoff	1.364	273	240,700,000	0.270	273	47,600,000	20%
Runoff	1.474	92	87,700,000	0.391	92	23,300,000	27%
		Total	328,400,000		**Total**	70,900,000	22%
2009							
Non-Runoff	1.477	273	260,500,000	0.426	273	75,100,000	29%
Runoff	1.623	92	96,500,000	0.452	92	26,900,000	28%
		Total	357,000,000		**Total**	102,000,000	29%
2010							
Non-Runoff	1.227	273	216,400,000	0.418	273	73,800,000	34%
Runoff	1.381	92	82,100,000	0.522	92	31,000,000	38%
		Total	298,500,000		**Total**	104,800,000	35%
2011							
Non-Runoff	1.365	273	240,800,000	0.313	273	55,200,000	23%
Runoff	1.389	92	82,600,000	0.313	92	18,600,000	23%
		Total	323,400,000		**Total**	73,800,000	23%
2012							
Non-Runoff	1.562	273	275,600,000	0.313	273	55,200,000	20%
Runoff	1.389	92	82,600,000	0.313	92	18,600,000	23%
		Total	358,200,000		**Total**	73,800,000	21%

cfs cubic feet per second
gpy gallons per year
Calculations based on EPA/ESAT flow monitoring data from 2009-2014. Overall flows for 2013 and 2014 are not shown because spring flows are not available for either year due to snowpack conditions. The average annual runoff flows from 2009-2012 and the average non-runoff flows from 2009-2014 were averaged to calculate the overall average runoff flow. Runoff averages included measurements made during May, June, July. Non-runoff averages included measurements made during other months of the year.

Variability of Gold King Mine Flow

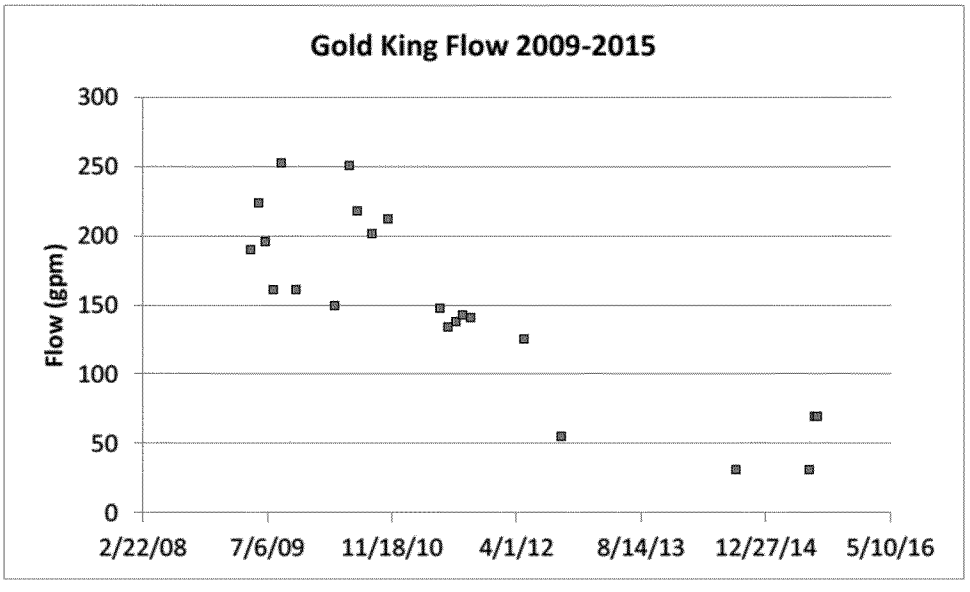
Gold King Mine flow data is available from 2009 through 2014, with multiple sampling events from 2009-2011 and fall sampling from 2012-2014. Gold King Mine spring flow was not measured from 2012 to the present due to high snow and potential avalanche conditions, and flow was not measured during fall 2013 due to the government shutdown. Flow was also measured by START during 2014 and 2015 site visits.

For years with multiple flow measurements (2009, 2010, 2011), the Gold King Mine discharge varied by up to 45 percent within 1 year (2009), when the November flow was 45 percent greater than the August flow.

The Gold King Mine discharge annual average runoff flow varied from the annual average non-runoff flow by up to 22 percent (2010).

Older historic data from START showed flow was 42 gpm in July 2005, 135 gpm in September 2005, and 314 gpm in October 2006. This widely variable flow may have been due to backup of water behind the American Tunnel reaching the elevation of the Gold King rather than an indication of the variability of flow from the Gold King Mine.

Measurements in 2015 included 31 gallons per minute (gpm) on June 24 (similar to Fall 2014), and 69 gpm on both July 15 and July 23.



Appendix F

Photos and Google Earth Images

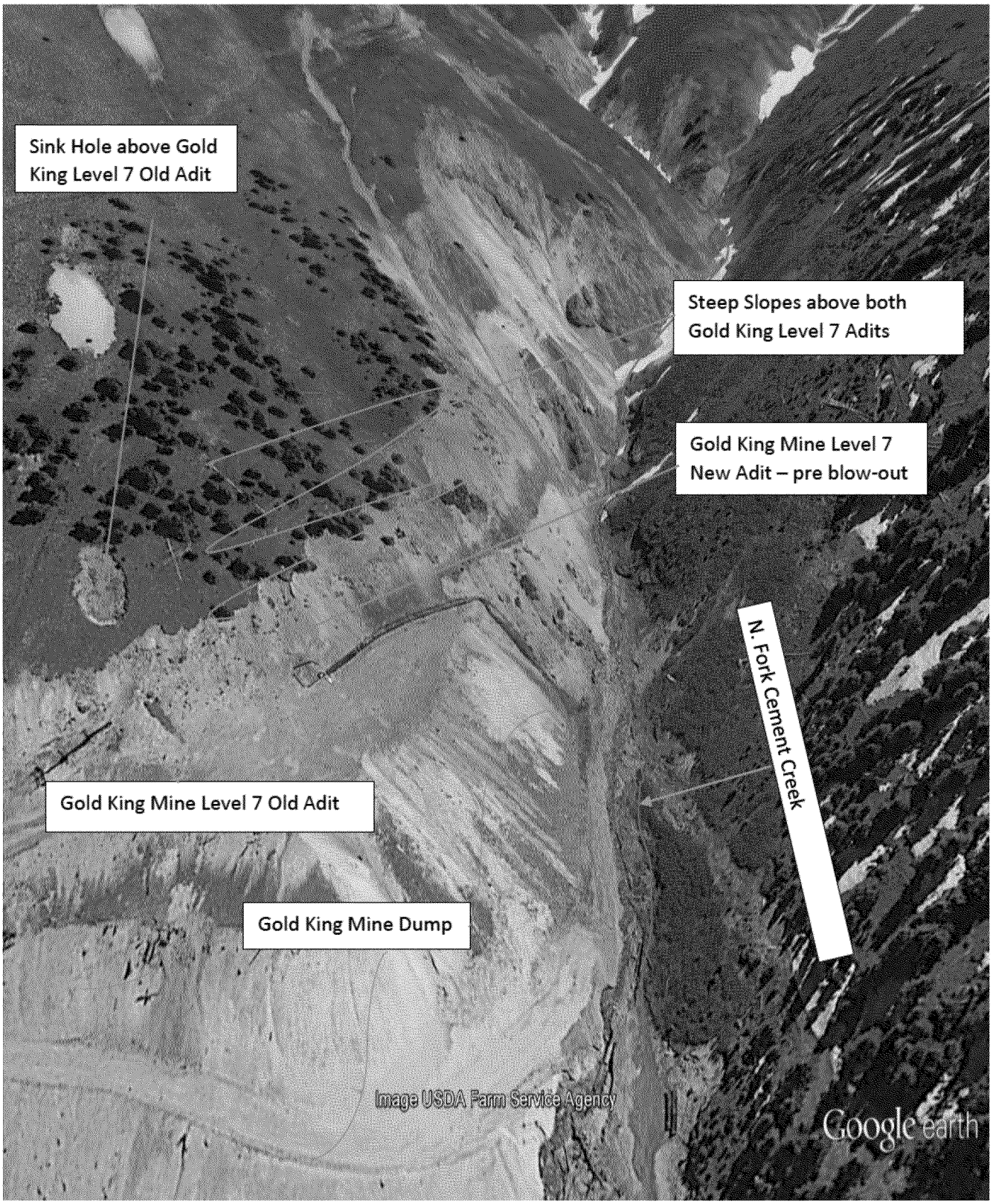


Photo 1 Google Earth June 2015 Image - Gold King Level 7 Adits and Mine Dump

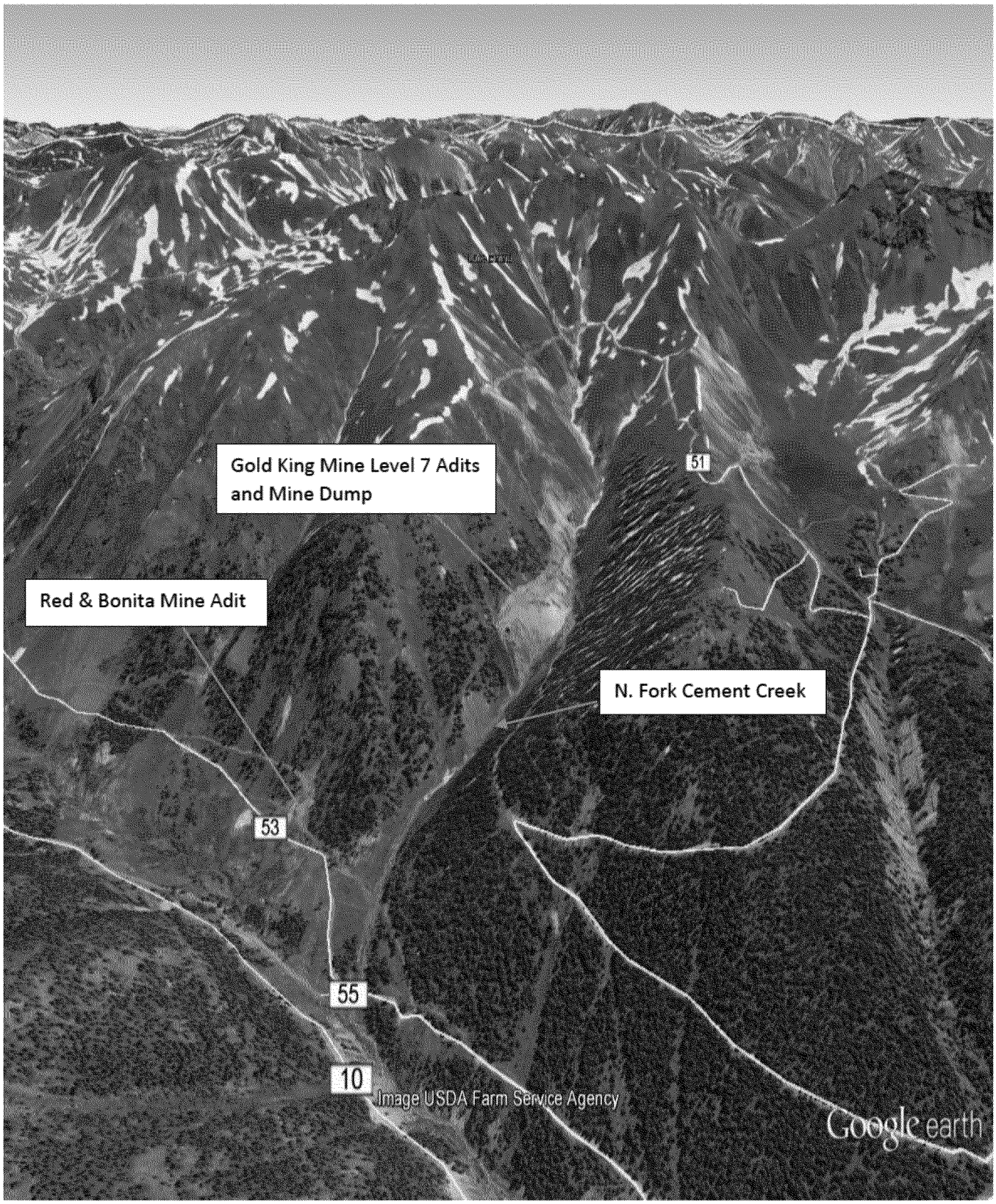


Photo 2 Google Earth June 2015 Image - Gold King Level 7 and Red & Bonita Mine Adits

Photo 3 August 18, 2015 – Sink Hole and Slope above Gold King Mine Old Adit

Photo 4 August 18, 2015 – Gold King Mine Level 7 Adit post-blowout